

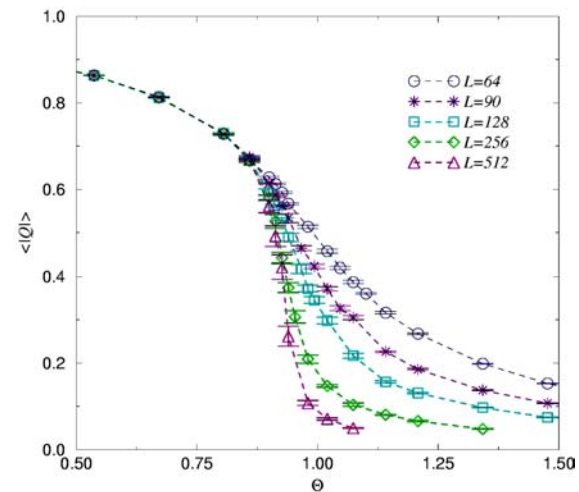
# Dynamic Phase Transition in Kinetic Ising Model Undergoing Hysteresis

**DMR-9871455:** PI: Mark A. Novotny, Mississippi State

University; co-PI: Per Arne Rikvold, Florida State University

**DMR-9981815:** PI: Per Arne Rikvold, Florida State University

Hysteresis occurs in bistable systems driven by an oscillating force that varies too fast for the system to follow its variations. At an intermediate, critical frequency the driven system undergoes a *dynamic phase transition* (DPT) between a low-frequency phase in which it can follow the field, and a high-frequency phase in which it is “frozen” into a near-stationary state. Remarkably, this far-from-equilibrium phase transition is in the *same universality class* as the Ising model in equilibrium. The DPT thus provides a bridge between equilibrium and non-equilibrium statistical physics. *Phys. Rev. E* **63**, 016120 (2001); **63**, 036109 (2001).



The dynamic order parameter  $Q$ , which is the period-averaged magnetization, shown vs the control parameter  $\Theta$ , which is the driving period normalized by the system's natural response time. For large  $\Theta$  (slow driving), the system follows the field, and  $Q$  approaches 0. For small  $\Theta$  (fast driving),  $Q$  is near unity. At the intermediate, critical  $\Theta_c$ ,  $Q$  vanishes with the system size  $L$  as  $L^{-\beta/\gamma}$ , where  $\beta$  and  $\gamma$  are critical exponents that determine the universality class.

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## **Education:**

One undergraduate student (Christina J. White Oberlin) and one postdoc (Gyorgy Korniss) were involved with this research. Oberlin received her BA in Physics from FSU in 2002 and will be a graduate student in Computer Science at The University of Wisconsin from Fall 2002. While working on this project she received a Goldwater Scholarship for 2000-02, and she won an NSF Graduate Fellowship for 2002-05. Korniss is a tenure-track Assistant Professor of Physics at Rensselaer Polytechnic Institute since 2000.

## **Outreach:**

The PIs and postdoc have participated in various outreach activities, such as science fairs and presentations at area schools. Oberlin was the President of the FSU chapter of The Society of Physics Students for 2000-01.

## **International Collaboration:**

This work involved a collaboration with Professor H. Fujisaka and Dr. H. Tutu, Department of Applied Analysis and Complex Dynamical Systems, Graduate School of Informatics, Kyoto University, Japan.